

Change Record

Document Number: ACC-D-GEN-OM003		
Document Title: Miner Mesh Locator (MML) Operation & Maintenance Guide		
Date	Document Revision	Comments
24 Jan. 2011	New	Initial release.
04 Oct. 2011	A	Updated battery pack.
16 Feb. 2012	B	Updated battery life, blasting proximity reference, and header.
13 Dec. 2012	C	Added statement on RF Exposure

Acronyms

Ah – Amp Hour
LED – Light Emitting Diode
MML – Miner Mesh Locator
MMR – Miner Mesh Radio
MOC – Mine Operations Center
MPC – Multi-purpose Connector
ms – Milli-seconds
V – Volts

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Safety Summary

This safety summary relates to the ACCOLADE Miner Mesh Locator (MML). Follow all precautions that appear here and throughout the guide. Ignoring warnings could result in death or serious injury. Ignoring cautions could result in minor or moderate injury, damage to equipment or property, or loss of system effectiveness.



WARNINGS

- Do not turn on or use the MML within 8 feet of explosives or blasting components. The MML's transmitted waveform characteristics are short duration (milliseconds/second) pulses, with a power level of one (1) watt or less. The MML is classified as a low-power RF source, as defined by the Institute of Makers of Explosives, Safety Library Publication No. 20.
- Do not replace the MML battery yourself. Only a qualified technician can remove or replace the MML battery. The MML is approved for use with the NiMH rechargeable battery assembly (part no. 1101-0083, drawing number SGL2.932.008PA), 3.6V.
- Charge the MML battery according to the manufacturer's directions in fresh-air locations only.
- Do not modify the MML or remove its cover, since a fire, electrical shock, or breakdown could result.

RF Exposure

The MML with its internal antenna complies with the Specific Absorption Rate (SAR) RF exposure requirements set forth for body worn equipment under all operating modes. The MML complies with the requirements specified in ANSI/IEEE Std. C95.1-1999 and FCC 47 CFR 2.1093 for the Uncontrolled Exposure/General population environment. It has been tested and evaluated in accordance with FCC OET Bulletin 65, Supplement C Edition 01-01.

1 • Overview

About this guide

This *Miner Mesh Locator (MML) Operation & Maintenance Guide* describes how to operate the Miner Mesh Locator (see Figure 1) for the ACCOLADE wireless mesh mine communications system.

Proximity to blasting components



WARNING

- **Do not turn on or use the MML within 8 feet of explosives or blasting components.**
 - The MML's transmitted waveform characteristics are short duration (milliseconds/second) pulses, with a power level of one (1) watt or less. The MML is classified as a low-power RF source, as defined by the Institute of Makers of Explosives, Safety Library Publication No. 20.



Figure 1. Miner Mesh Locator (MML)

2 • MML Controls

Figure 2 shows the Miner Mesh Locator and identifies its controls.

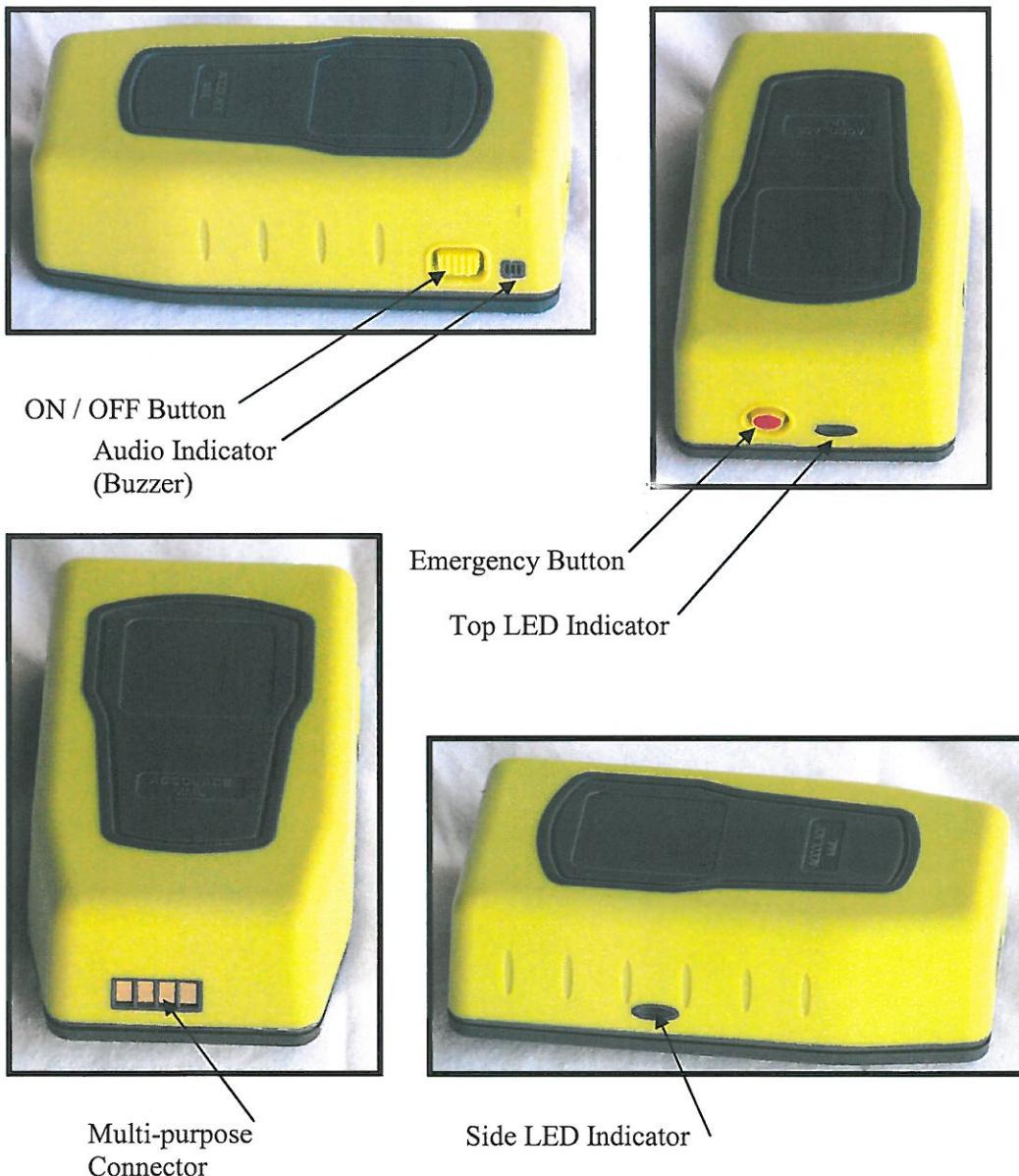


Figure 2. Controls on the Miner Mesh Locator

ON/OFF switch

- When pressed for four (4) seconds, toggles the unit between the ON and OFF states.

Emergency switch

- When the emergency switch is pressed and held down for two (2) seconds, the MML enters Emergency Mode.
- The emergency switch is also used to cancel the Emergency Mode. When in Emergency Mode the MML can clear the emergency indicators by pressing the Emergency button for four (4) seconds.

LED Indicators

- There is one dual-color LED indicator on the top and one dual-color LED indicator on the side of the MML. The colors are red and green.
- The red and green lights indicate the status of the MML. See Table 1.

Table 1. Indicators

Mode	Green LED	Red LED	Buzzer
Normal – ON and in the ACCOLADE Mesh Network	200 ms flash every 5 seconds	OFF	OFF
Outside ACCOLADE mesh network	200ms flash every second	OFF	Starts when outside the network for 1 minute. 500 ms tone every four minutes thereafter.
Low Battery	OFF	200 ms flash every 5 seconds	Two 500 ms tones separated by 1 second every ten minutes.
MML Self-declared Local Emergency Mode	OFF	200ms flash every second	200 ms tone every one second. Note: This is halted if the MOC Emergency Acknowledgement text is not received within 5 seconds.
Network-Initiated Emergency Mode	OFF	Solid on	500 ms tone every 5 seconds.
Emergency Acknowledgment from MOC	Solid On for 10 seconds		5-second tone.

Audio Indicator

- The audio indicator indicates the state of the MML. See Table 1.

Multi-purpose connector (MPC)

- The MPC serves as the interface point between the MML and other hardware.
- The MPC provides contacts to:
 - Charge battery.
 - Update the operational software.

Battery

- The battery pack is composed of three NiMH cells that supplies a nominal 3.6 VDC with a capacity of 1.65 Ah up to 2.20 Ah.
 - The MML constantly receives from the mesh and transmits its status to the Mine Operation center (MOC) through the mesh network. The MML can operate in excess of 16 hours, under any and all conditions on a fully charged battery. The worse case average current draw occurs during Network-Initiated Emergency Mode and was measured as 88 mA.
 - Note that as with all battery-powered devices, temperature and storage conditions can reduce battery life. To maximize battery life, store in a cool place (-20°C to 30°C (-4°F to 86°F) with humidity from 40% to 80%. Minimize exposure to high heat above 50°C (122°F). Fully charge the battery prior to long-term storage. When in long-term storage, recharge every three months.
- The battery maximum output voltage may be as high as 4.2 V, and may go as low as 3.0 V due to temperature and discharge.



WARNING

- Do not replace the MML battery yourself. Only a qualified technician can remove or replace the MML battery. The MML is approved for use with the NiMH rechargeable battery assembly (part no. 1101-0083, drawing number SGL2.932.008PA), 3.6V, 1.65 Ah.

3 • MML Operation

The MML is a tracking, mesh status and emergency status indication device. It requires minimal user interaction. The MML goes into sleep mode when inserted in its charging cradle and activates (turns ON) when removed from its charging cradle. The user need not turn it ON and OFF with the ON/OFF button, although he can if he chooses to. The LEDs and audio indicator convey the MML's status, as shown in Table 1.

The MML is a transceiver and therefore, in addition to allowing the Mine Operation Center (MOC) to track the MML, it provides valuable feedback to the MML user.

- The MML indicates when it goes outside the ACCOLADE mesh network. This tells users they are no longer being tracked and that they can no longer declare an emergency.
- The MML indicates when an Emergency it has declared has been received by the MOC.
- The MML indicates when the MOC has cleared an Emergency.

Normal Mode

Normal Mode is defined as inside the ACCOLADE mesh network, with no Emergency declared and the MML's battery at greater than 10%.

Outside the Network Mode

This is entered when the MML does not receive the ACCOLADE mesh network for greater than 1 minute.

Low Battery Mode

Low Battery Mode is defined as when the battery is less than 10 % charged. The remaining operating time of the MML when the low battery indicator activates is greater than two hours. The MML user should go above ground and recharge the MML when this mode is entered.

Emergency Mode

Each MML has an individual Node ID. The MML shall ignore all mesh network voice and data traffic except:

- “All-call” messages from the MOC.
- Broadcast voice or text calls.
- Voice or text calls addressed to its individual Node ID.

Emergency mode is entered by the MML or when the MML detects emergency traffic directed to the entire mine (broadcast or “all-call”) or specifically directed to its node ID.

MML Self-declared Local Emergency Mode

The MML user may initiate an emergency by pressing the emergency button for 2 seconds.

1. This shall cause the MML to send a broadcast emergency text message “Emergency Declared” and enter Local Emergency Mode.
 - Other MMLs receiving this message enter Network-Initiated Emergency Mode.
 - The MOC acknowledges by sending an Emergency Ack message.
 - If the initiating MML does not receive this acknowledgement from the MOC within 5 seconds, the intermittent buzzer will cease leaving just the flashing red LED indication. In this state, the user may re-initiate the emergency (in the hope of receiving an acknowledgement) by pressing the emergency button for two seconds. After the button has been held down for two seconds, the MML shall continue as described in step 1 (above). If the button is held for 4 seconds or more, the MML shall continue as described in step 4 (below).
2. If the initiating MML receives the acknowledgement within 5 seconds, it shall turn on the green LED and the buzzer. The buzzer shall turn off after 5 seconds. The green LED shall remain on for a further 5 secs (10 seconds total) and then turn off, leaving just the flashing red indication.
3. While the MML is in local emergency mode, the user may, at any time, cancel the emergency by pressing the emergency button for 4 or more seconds. In this case, the MML shall continue as described in step 4 (below).
4. If the user cancels the local emergency by pressing the emergency button, the MML shall send a non-emergency broadcast text message “Emergency Cancelled” to notify all other units and the MOC and then revert to normal mode.

Network-Initiated Emergency Mode

When not in emergency mode, MML shall enter the Network-Initiated Emergency Mode upon receipt of any of the following:

- Emergency broadcast voice from any source.
 - Emergency broadcast text from any source.
 - Any all-call communication from the MOC.
- When MML is in a Network-Initiated Emergency Mode, receipt of non-emergency text or voice from the ID that initiated the emergency or from the MOC causes the MML to revert to normal mode.
- When MML is in a Network-Initiated Emergency Mode, the user may, at any time, cancel the emergency by pressing the emergency button for 4 seconds. In this event, the MML shall revert to normal mode.
- While in (local or network initiated) emergency mode, the MML shall ignore all-call voice messages.
 - Note: This is different from the MMR, which reverts to normal mode after receiving all-call voice messages.

4 • Maintaining the MML

MML maintenance consists of charging the MML and replacing the battery.

Charging an MML

- Charge the MML to full capacity before use in fresh-air locations only (above ground). Fully charging takes less than 8 hours.
- Each full charge lasts 24 hours or more under nominal conditions.
- Recharge each MML after each miner finishes his shift – whether it's a single shift (8 hours) or double shift (16 hours). Do NOT give the MML to another miner unless it has been recharged for at least 8 hours.
- Charge unused MMLs to capacity in a fresh-air location only, check them once a quarter, and recharge as needed.



WARNING

- Charge the MML battery according to the manufacturer's directions in fresh-air locations only.

Replacing the MML's battery

Have a qualified technician replace the battery after 500 charging cycles.



WARNING

- Do not replace the MML battery yourself. Only a qualified technician can remove or replace the MML battery. The MML is approved for use with the NiMH rechargeable battery assembly (part no. 1101-0083, drawing number SGL2.932.008PA), 3.6V.

5 • Specifications

MML specifications

- Operating Frequency: 902 to 928 MHz.
- Transmit Output Power Level: 1 Watt maximum.
- Battery Life: 16 hours minimum.

Environmental specifications

- Operating Temperature: -20°C to +40°C.
- Storage Temperature: -20°C to +40°C.
- Impact Resistant.
- Ingress Protection: Water-resistant and dustproof to levels specified for IP54 enclosures.